INTERNATIONAL STANDARD

ISO 105-B10

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Textiles — Tests for colour fastness —

Part B10: Artificial weathering — Exposure to filtered xenon-arc radiation

Textiles — Essais de solidité des coloris —

Partie B10: Exposition aux intempéries artificielles — Exposition au rayonnement filtré d'une lampe à arc au xénon

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 105-B10 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

ISO 105 consists of many parts designated by a part letter and a two-digit serial number (e.g. A01), under the general title *Textiles — Tests for colour fastness*. A complete list of these parts is given in ISO 105-A01.

Introduction

All four exposure conditions described in this part of ISO 105 are different from the method described in ISO 105-B04. This part of ISO 105 is not intended to replace ISO 105-B04 but to specify additional test options. Nevertheless, ISO/TC 38 might consider withdrawing ISO 105-B04 at a later date, after the textile industry has been able to achieve comprehensive experience using this part of ISO 105.

Textiles — Tests for colour fastness —

Part B10:
Artificial weathering — Exposure to filtered xenon-arc radiation

1 Scope

This part of ISO 105 specifies a procedure for exposing textiles to artificial weathering in xenon-arc apparatus, including the action of liquid water and water vapour, in order to determine the weather resistance of the colour of textiles. The exposure is carried out in a test chamber with a filtered xenon-arc light source simulating solar spectral irradiance according to CIE 85:1989, Table 4. The method can be used either for determining the colour fastness or the ageing behaviour of the textile under test. The method is also applicable to white (bleached or optically brightened) textiles.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 105-A01:2010, *Textiles — Tests for colour fastness — Part A01: General principles of testing*

ISO 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 105-A05, *Textiles — Tests for colour fastness — Part A05: Instrumental assessment of change in colour for determination of grey scale rating*

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 4892-1, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*

ISO 9370, *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

CIE[1)] Publication No. 15, *Colorimetry* (Third edition)

CIE Publication No. 51.2, *A method for assessing the quality of daylight simulators for colorimetry*

CIE Publication No. 85:1989, *Solar spectral irradiance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
reference material
material of known performance

3.2
reference specimen
portion of the reference material that is to be exposed

1) Commission Internationale de l'Éclairage, CIE Central Bureau, Kegelgasse 27, A-1030 Vienna, Austria; http://www.cie.co.at.

3.3
control material
material which is of similar composition and construction to the test material and which is exposed at the same time for comparison with the test material

3.4
control specimen
portion of the control material that is to be exposed

3.5
radiant exposure
H
amount of the radiant energy, to which a specimen has been exposed, given by the equation

$$H = \int E \cdot \mathrm{d}t$$

where

E is the irradiance, in watts per square metre;

t is the exposure time, in seconds.

NOTE 1 H is expressed in joules per square metre.

NOTE 2 If the irradiance E is constant throughout the whole exposure time, the radiant exposure H is given simply by the product of E and t.

3.6
ageing behaviour
change in a property of a textile specimen during artificial weathering

NOTE One measure of ageing is the radiant exposure H in the wavelength range below 400 nm or at a specified wavelength, e.g. 340 nm. The ageing behaviour of a textile exposed to artificial weathering, or to artificial radiation, depends on the type of textile, the conditions of exposure of the textile, the property selected for monitoring the progress of the ageing process and the degree of change in this property.

3.7
ageing criterion
given degree of change in a selected property of the textile under test

NOTE The ageing criterion is specified or agreed upon.

4 Principle

A specimen of the textile to be tested is exposed to artificial radiation from a xenon-arc lamp with or without periodical wetting. The colour fastness is assessed by comparing the change in colour of the specimen using the grey scale.

The ageing behaviour is assessed by measuring the degree of change of a selected property, e.g. tensile strength, compared to an unexposed specimen, using the appropriate test method. The ageing criterion has to be agreed on by the interested parties and should preferably be one that is important for the practical end-use of the textile under test.

5 Apparatus and reference materials

5.1 Laboratory light source

5.1.1 General

The light source shall be one or more quartz-jacketed xenon-arc lamps, which emit radiation from about 270 nm in the ultraviolet through the visible spectrum and into the infrared. In order to simulate global solar radiation at the earth's surface as described in CIE 85:1989, Table 4, so-called daylight filters shall be used to remove short wavelength UV radiation $<$290 nm. In addition, filters to remove infrared radiation may be used to prevent unrealistic heating of test specimens that may cause thermal degradation not experienced during outdoor exposures.

NOTE Solar spectral irradiance for a number of different atmospheric conditions is described in CIE 85:1989. In accordance with other International Standards, this part of ISO 105 uses Table 4 in CIE 85:1989 as a benchmark for solar spectral irradiance.

The xenon-arc light source may be either air-cooled or water-cooled. Size, form and number of xenon-arc lamps will depend on the type of apparatus. An irradiance-controlled light source shall be used.

The variation in irradiance over the area covered by the specimens shall not exceed $\pm$10 % of the mean. If this cannot be achieved, specimens shall be periodically repositioned to provide equivalent exposure periods in each location.

The characteristics of xenon-arc lamps and filters are subject to change during use due to ageing, and lamps and filters shall be replaced at suitable intervals. Furthermore, they are subject to change due to the accumulation of dirt and shall therefore be cleaned at suitable intervals. Follow the manufacturer's recommendations for replacement and cleaning of lamps and filters.

5.1.2 Spectral irradiance

Appropriate optical filters are used to reduce the xenon-arc emission in order to simulate daylight (CIE 85:1989, Table 4). The minimum and maximum levels for the relative spectral irradiance in the UV wavelength range of radiation are given in Table 1.

Table 1 — Relative spectral irradiance for xenon-arc with daylight filters[ab]

Spectral bandpass wavelength, λ nm	Minimum %[c]	CIE 85:1989, Table 4 %[de]	Maximum %[c]
$\lambda \leq 290$	—	—	0,15
$290 < \lambda \leq 320$	2,6	5,4	7,9
$320 < \lambda \leq 360$	28,2	38,2	39,8
$360 < \lambda \leq 400$	54,2	56,4	67,5

[a] Data in this table are the irradiance in the given bandpass expressed as a percentage of the total irradiance from 290 nm to 400 nm.

[b] The minimum and maximum data in this table are based on more than 100 spectral irradiance measurements for water-cooled and air-cooled xenon-arc instruments with daylight filters from different production lots and various ages (see ISO 4892-2), in accordance with the recommendations of the manufacturer. The minimum and maximum data are at least three sigma limits from the mean for all measurements.

[c] The minimum and maximum columns will not necessarily sum to 100 % because they represent the minimum and maximum for the data used. For any individual spectral irradiance, the calculated percentage for the bandpasses in this table will sum to 100 %. For any individual xenon-arc lamp with daylight filters, the calculated percentage in each bandpass shall fall within the minimum and maximum limits given. Test results can be expected to differ if obtained using xenon-arc devices in which the spectral irradiances differed by as much as that allowed by the tolerances. Contact the manufacturer of the xenon-arc device for specific spectral irradiance data for the xenon-arc and filters used.

[d] The data from Table 4 of CIE 85:1989 represent global solar spectral irradiance on a horizontal surface with an air mass of 1, column ozone of 0,34 cm at standard temperature and pressure (STP), 1,42 cm precipitable water vapour, and spectral optical depth of aerosol extinction of 0,1 at 500 nm. These data shall always serve as target values for xenon-arc lamps with daylight filters.

[e] For the solar spectrum represented by Table 4 in CIE 85:1989, the UV irradiance (290 nm to 400 nm) is 11 % and the visible irradiance (400 nm to 800 nm) is 89 %, expressed as a percentage of the total irradiance from 290 nm to 800 nm. These percentages of UV irradiance and visible irradiance on samples exposed in xenon-arc devices may vary due to the number and reflectance properties of specimens being exposed.

5.2 Test chamber

The design of the test chamber may vary, but it shall be constructed from inert material. The test chamber shall provide means for measurement and control of irradiance, black-standard or black-panel temperature, chamber air temperature and relative humidity. It shall also provide a system to provide humidification, a device for wetting the surface of the samples and a frame to carry specimen holders.

5.3 Radiometer

A radiometer for measuring irradiance either in the range from 300 nm to 400 nm, or at 340 nm, depending on the type of apparatus used. The radiometer shall comply with the requirements outlined in ISO 9370 and ISO 4892-1.

5.4 Temperature sensors

5.4.1 General

Temperature sensors are used both for measurement of the air temperature within the test chamber, and for the measurement of a black surface to control the surface temperatures of the samples during exposure.

5.4.2 Black-standard thermometer (BST) and black-panel thermometer (BPT)

Black-surface sensors are exposed to direct irradiance in a similar way as the samples. Settings for the insulated black-standard temperatures are given in Table 2. The paragraph after the note below Table 2 recommends settings for the uninsulated black-panel temperatures. Both surface temperatures have no relationship to each other. Therefore, the test results may not be comparable. Both types shall comply with the requirements outlined in ISO 4892-1. Generally, BST and BPT do not give the same readings.

In weathering devices where specimens are positioned in a flat plane in front of a light source, a black-standard thermometer shall be used.

NOTE 1 The BST differs from the BPT because the black plate of the BST is fixed on a thermally insulated mounting. The temperatures measured therefore correspond approximately to those measured on the exposed surface of the test specimen with a black or dark-coloured coating on a substrate of low thermal conductivity. The surface temperatures of light-coloured test panels will usually be lower.

NOTE 2 The surface temperature of a test specimen depends on a number of factors, including the amount of radiation absorbed, the amount of radiation emitted, thermal-conduction effects within the test specimen and heat transfer between the test specimen and the air, and between the test specimen and the sample holder, and cannot therefore be predicted with accuracy.

NOTE 3 At conditions used in typical exposures (no high irradiance), the temperature indicated by a BST typically will be approximately 2 K to 5 K higher than that indicated by a BPT.

NOTE 4 The black-standard thermometer is also called insulated black-panel thermometer. The black-panel thermometer is also called uninsulated black-panel thermometer.

5.4.2.1 Black-standard thermometer (BST)

The black-standard thermometer for measuring the black-standard temperature in the plane of the test specimens during the dry period shall consist of a plane (flat) stainless-steel plate with a thickness of about 0,5 mm to 1,0 mm. A typical length and width is about 70 mm by 40 mm. The surface of this plate facing the light source shall be coated with a black layer that has good resistance to ageing. The coated black plate shall absorb at least 90 % of all incident flux up to 2 500 nm. A platinum resistance sensor shall be attached in good thermal contact to the centre of the plate on the side opposite the radiation source. This side of the metal plate shall be attached to a 5 mm thick base-plate made of unfilled poly(vinylidene fluoride) (PVDF). A small space that is sufficient to hold the platinum resistance sensor shall be machined in the PVDF base-plate. The distance between the sensor and the recess in the PVDF plate shall be about 1 mm. The length and the width of the PVDF plate shall be sufficiently large to ensure that no metal-to-metal thermal contact exists between the black-coated metal plate and the mounting holder into which it is fitted. The metal mounts of the holder of the insulated black panel shall be at least 4 mm from the edges of the metal plate. Black-standard thermometers which differ in construction are permitted, as long as the temperature indicated by the alternative construction is within $\pm$1,0 °C of that of the specified construction at all steady-state temperature and irradiance settings the exposure device is capable of attaining. In addition, time needed for the alternative black-standard thermometer to reach the steady state shall be within 10 % of the time needed for the specified black-standard thermometer to reach the steady state.

5.4.2.2 Black-panel thermometer (BPT)

The black-panel thermometer for measuring the black-panel temperature in the plane of the test specimens during the dry period shall consist of a plane (flat) metal plate that is resistant to corrosion. Typical dimensions are about 150 mm long, 70 mm wide and 1 mm thick. The surface of this plate facing the light source shall be coated with a black layer that has good resistance to ageing. The coated black plate shall absorb at least 90 % of all incident flux up to 2 500 nm. A thermally sensitive element shall be firmly attached to the centre of the exposed surface. This thermally sensitive element can be a black-coated stem-type bimetallic coil thermometer with a dial display or a resistance thermometer. The back of the metal panel shall be open to the atmosphere within the test chamber.

5.4.3 Chamber air-temperature sensor

The sensor for measuring the air temperature in the test chamber may either be a thermometer, a thermocouple or a thermal resistor. It shall be fixed in a position where the air temperature is similar to that in front of the samples, but shielded from the direct radiation from the xenon-arc lamp.

5.5 Wetting and humidity-control equipment

5.5.1 General

Specimens may be exposed to moisture in the form of water spray, condensation or immersion. The specific procedures and exposure conditions used shall be included in the test report.

NOTE The level of relative air humidity can have a significant influence on photo degradation of textiles.

5.5.2 Relative-humidity sensors

Humidity sensors have to be shielded from direct radiation. They can either be electronic humidity sensors, or of the “wet bulb” type, where the humidity is defined by the difference in the air temperature within the test chamber. The location of sensors used to measure humidity shall be according to ISO 4892-1.

5.5.3 Device for wetting the samples

The test chamber shall be equipped with a means to either introduce intermittent water spray onto the front of the test specimens, or to immerse the specimens completely in water, under specified conditions. Water spray shall be uniformly distributed over the specimens. The spray system shall be made from corrosion-resistant materials that do not contaminate the water employed. In case of immersion, the BST or BPT sensor shall also be completely immersed.

Water sprayed on specimen surfaces shall have a conductivity below 5 µS/cm, contain less than 1 µg/g dissolved solids and leave no observable stains or deposits on the specimens. Care shall be taken to keep silica levels below 0,2 µg/g. A combination of deionization and reverse osmosis can be used to produce water of the desired quality.

NOTE Wetting of the samples by water spray or by immersion does not necessarily lead to similar results.

5.6 Specimen holders

Specimen holders shall be made of inert materials that will not affect the test results. They are preferably made in the form of an open frame. If required, a metal plate can be used to close the sample holders from the rear.

Additional devices may be used to mount different types of specimens. Specifically, an open inner metal frame, which can take up thin textile specimens sewn to a ring, can be used inside the main frame. Otherwise, inert materials, such as metal or specifically neutral plastic sheets, are used to mount specimens. White cardboard without an optical brightener can be used when applying exposure conditions without water spray.

Opaque covers may be used to partly cover the front of the specimens, made from inert materials, for example thin sheets of aluminium or plastic. White cardboard without an optical brightener can be used when applying exposure conditions without water spray.

Places not used for samples shall be filled with dummy samples, for example sample holders containing specifically neutral plastic sheet or dull stainless steel, in order to obtain uniform exposure conditions.

Details on specimen holders and mounting of the specimens shall be included in the test report.

5.7 Spectrophotometer

The spectrophotometer for colorimetric measurement of colour differences including the appropriate software shall comply with ISO 105-A05.

5.8 Colour-matching lamp

The colour-matching lamp for assessing change in whiteness shall be in accordance with CIE 15 or CIE 51.2.

5.9 Grey scale for assessing change in colour

The grey scale shall be in accordance with ISO 105-A02.

5.10 Reference materials

It is recommended to use appropriate reference materials (see 3.1) to check the exposure apparatus and operating conditions by monitoring the known function of the reference material in change of colour (or a different suitable property) depending on the radiant exposure.

For sets of exposure conditions A and C, the use of Blue Wool References 1 – 8 or L2 – L9 is not recommended, as these are not designed for exposure to wetting.

NOTE 1 An orange-pigmented lacquer applied on thin aluminium sheet, as used in plastic and polymer coating industries, can be used to check the apparatus. This reference material is mainly sensitive to irradiance, and to water spray intensity, if applicable. Nevertheless, there are no data available yet on the use of this material for this application (Shipping address: EMPA, Überlandstrasse 129, CH-8600 Dübendorf, Switzerland).

NOTE 2 Manufacturers of reference materials can supply their customers with certificates providing the function of the change of colour or a different suitable property depending on the radiant exposure or test duration, under specified exposure conditions.

5.11 Metal or clear plastic sheet (PMA)

Sheets made of solid inert material [metal or clear plastic (PMA)], on which to mount the textile specimens (see 6.1.3).

6 Test specimens

6.1 For artificial weathering with water spray

6.1.1 If more than one sample is mounted in the same sample holder in an upright position, staining can occur on the lower samples from dye washed out from the upper samples. In case this has happened, the stained samples shall be discarded and exposure shall be repeated.

6.1.2 Open loop method: A piece of textile is cut to approximately 40 mm × 100 mm, sewn into a ring and wrapped tightly fitting round a 40 mm wide frame made from a metal wire of approximately 4 mm in diameter. If open sample holders are used, a metal plate should be fitted to the rear in order to close it. The whole front of the specimen shall be exposed.

6.1.3 Alternatively, a piece of textile not less than 30 mm × 45 mm is mounted onto a solid inert material, e.g. metal, or preferably a clear plastic sheet (PMA). Exposure of the whole surface without covering is preferred, but if desired, samples can be partly covered, using inert covers made from thin aluminium or opaque plastic sheet. The covers should be in close contact to the specimens in order to mark sharp lines between exposed and covered areas. The covers can be applied as usual from left to right. However, covering from the top down is recommended in order to minimize water retention inside the sample holders if bigger samples are available (e.g. 100 mm × 45 mm) or more than one step exposure is required, using covers of increasing sizes from step to step.

6.1.4 Yarn is wound parallel and close together round an open frame as described in 6.1.2, or round a plastic or metal sheet as in 6.1.3, with the ends fixed in an appropriate way. The windings can either be horizontal or vertical, and the width of the resulting yarn stack shall not be below 30 mm. When physical properties (e.g. tensile strength) have to be tested after exposure, the exposed yarn lengths shall be at least 100 mm and the single threads should be arranged in a distance from each other in order not to overlap; no covers are used in this case.

6.1.5 Loose material can either be sewn onto inert fabric as a support, e.g. polypropylene, and then be handled as described in 6.1.2, or it will be combed and stuck on a plastic sheet in a way such that the loose ends are fixed on the rear of a metal or plastic sheet (see 6.1.3) with waterproof adhesive tape.

6.2 For artificial weathering without water spray

One or more pieces of textile fabric of a size not less than 45 mm × 10 mm are mounted parallel on a white cardboard that does not contain optical brighteners. Usually, half of the specimens are covered using inert covers made from thin aluminium or opaque plastic sheet. Alternatively, exposure with two or more steps by applying covers of increasing size is possible, or specimens can be exposed without a cover at all. Materials other than fabric, e.g. yarn or loose material, are mounted as described in 6.1.4 or 6.1.5.

7 Exposure conditions

7.1 Sets of exposure conditions

Table 2 specifies four different sets of exposure conditions: A to D. These preferred sets of exposure parameters simulate global solar radiation (daylight), combined with temperature and irradiance levels that are close to the maximum values found in the respective corresponding climatic conditions. Sets of exposure conditions A and B are the usual exposure parameters for moderate to warm climate conditions; sets of exposure conditions C and D are to be used for extreme requirements only. Other sets of exposure conditions are not specifically recommended, but can be selected according to individual needs, as agreed upon between interested parties.

Table 2 — Sets of exposure conditions

Set of exposure conditions	A	B	C	D
Corresponding climatic conditions	moderate with rain	moderate without rain	semi-tropical with rain	semi-arid without rain
Spectral irradiance at 340 nm [W/(m^{2}nm)]	0,51 ± 0,02	0,51 ± 0,02	0,51 ± 0,02	0,51 ± 0,02
Irradiance between 300 nm and 400 nm (W/m^2)	60 ± 2	60 ± 2	60 ± 2	60 ± 2
Black-standard temperature (°C)	65 ± 3	65 ± 3	82 ± 3	82 ± 3
Chamber air temperature (°C)	38 ± 3	38 ± 3	47 to 53	47 to 53
Relative humidity (%)	50 ± 10	50 ± 10	65 ± 10	27 ± 3
Dry phase, light on	102 min	continuous	90 min	continuous
Wetting phase, light on	18 min	—	30 min	—

NOTE Other irradiance levels than those specified in Table 2 can be used if agreed between the interested parties. For example, in Japan irradiance levels up to 180 W/m^2 in the wavelength range 300 nm to 400 nm have been used to achieve higher acceleration, and in the USA spectral irradiance of 0,35 W/(m^{2}nm) at 340 nm has been used.

If a black-panel thermometer is used instead of a black-standard thermometer, the black-panel temperature has to be agreed between the interested parties. Preferably, set the black-panel temperature to 63 °C (sets of exposure conditions A and B) or to 77 °C (sets of exposure conditions C and D). See also 5.4.2.

Wet textile samples cannot be assessed for change of colour. For more convenient sample handling, it can be agreed by the interested parties that the exposure should end with a dry phase, even if the specified exposure duration ends within the wet phase.

7.2 Exposure duration

Exposure durations are vastly dependent on the requirements and the use of textile specimens to be tested. Typical exposure durations, taking into consideration the efficient handling in the laboratory, are given in Annex A.

7.3 Correlation

The correlation between the exposure conditions for artificial xenon-arc weathering and real outdoor exposure depends considerably on the actual site of natural exposure, as well as on the individual sensitivity of any kind of textile material to any of the individual climatic parameters, and finally to the material's property that is evaluated.

8 Procedure

8.1 Checking of the apparatus

Make sure that the apparatus is operating under the specified set of conditions given in Clause 7 and that the measurement sensors are working properly and are calibrated according to the manufacturer's recommendation. Maintain these conditions throughout the exposure.

If reference material is available and is used, a reference specimen is exposed in the apparatus for a certain duration under the specified exposure conditions. Before and after exposure, the colour is measured and the resulting ΔE^*(CIELab) value is compared with the known value of the reference material. If the value does not lie within the given tolerances, the exposure apparatus has to be readjusted. Reasons for deviations can be

— differences in irradiance adjustment or measurement by the test apparatus,

— differences in temperature,

— differences in the position of the reference within the test apparatus, or

— exposure apparatus not properly calibrated.

8.2 Mounting of the test specimens

Attach the specimens to the appropriate specimen holders, including, if applicable, means to partly cover the surface of the specimen. Covering arrangements depend on agreement of the parties involved, the type of exposure conditions and the preparation of test specimens as described in Clause 6. Identify the specimens by suitable indelible markings.

For higher uniformity of the test results during long-term exposure, it can be useful to change the position of each specimen periodically. However, this is not recommended for a short time exposure.

8.3 Exposure

8.3.1 Exposure for a fixed duration or radiant exposure

Expose the specimen or group of specimens simultaneously under the specified set of exposure conditions for the desired duration or radiant exposure. Change covers if applicable according to the positioning and timing protocol that has been agreed on by the parties involved. When finished, remove specimens from the sample holders and store them in the dark under normal ambient conditions for at least 5 h under the standard conditions specified in ISO 139 to allow acclimatization and relaxation.

8.3.2 Exposure to a control material

Expose the specimen or group of specimens simultaneously, together with the control material, under the specified exposure conditions. Regularly check the specimen(s) in comparison to the control specimen, until a colour difference can be clearly identified on the control specimen between the exposed and the original control material (weathering with wetting) or the covered part (weathering without wetting). Stepwise exposure, by covering parts of the exposed samples and the control specimen, can be applied as before.

When finished, remove specimens from the sample holders and store them in the dark under normal ambient conditions for at least 5 h under the standard conditions specified in ISO 139 to allow acclimatization and relaxation.

9 Assessment

9.1 Colour change

Assess the relevant colour changes under suitable illumination as described in ISO 105-A01:2010, Clause 15.

For tests with water spray (options A and C), the exposed part of the specimen is assessed against the original sample.

For tests without water spray (options B and D), the exposed part of the specimen is assessed against the covered part of the specimen.

The assessment is done either by using the grey scale for colour change according to ISO 105-A02, or by using spectrophotometric measurements, followed by calculation of corresponding grey scale ratings according to ISO 105-A05. Ratings are in the range between 5 (no visible colour change) to 1 (very strong colour change).

As an alternative, results obtained by colorimetric measurement may be given in ΔE^* (CIELab) values or other colorimetric systems, if agreed upon between interested parties.

The comparison to a control material that has been agreed upon, by using the exposure method described in 8.3.2, is an allowed alternative. The result will be given as “satisfactory” if the specimen under test has the same or a lower colour difference than the control specimen, or as “unsatisfactory” if the specimen under test has a higher colour difference than the control specimen.

9.2 Ageing behaviour

Assess the change in the selected property (ageing criterion) in accordance with the appropriate test standard.

NOTE ISO 4582 contains a lot of information and relevant standards about specific assessments of specimens after exposure.

10 Test report

The test report shall contain at least the following information:

a) a reference to this part of ISO 105 (ISO 105-B10:2011);

b) all details necessary to identify the sample tested;

c) the type of exposure apparatus used;

d) the set of exposure conditions applied (A, B, C or D) and the individual exposure parameters;

e) if a BST or BPT sensor was used and details about this sensor;

f) the method used to provide wetting of the specimens (spray or immersion);

g) the irradiance between 300 nm and 400 nm, or the spectral irradiance at 340 nm;

h) the radiant exposure between 300 nm and 400 nm, or the spectral radiant exposure at 340 nm;

i) the duration of exposure;

j) details on specimen holders and mounting of the specimens;

k) whether the specimens were turned about their longitudinal axis or maintained in their position facing the xenon-arc lamp;

l) the test result:

   — as the numerical grey scale rating (1 to 5),

   — or as the numerical colour difference value resulting from spectrophotometric measurement, in addition also expressed as the grey scale rating,

   — or as either “satisfactory” or “unsatisfactory” when tested against a control material;

m) details of any reference specimens or control specimens exposed;

n) whether the exposure was carried out in stages or not;

o) any deviation from the test methods specified;

p) the date of the test.

Annex A
(informative)

Typical applications and test durations

Type of application	Typical radiant exposure[a] between 300 and 400 nm MJ/m^2	Typical spectral radiant exposure[b] at 340 nm kJ/(m^{2}nm)	Typical test duration[ab] h
Apparel preferably used outdoors under daylight and direct weather conditions, e.g. sportswear, uniforms.	9,5 to 19	81 to 162	44 to 88
Indicative test for apparel, designed for occasional or part-time outdoor use only.	1,7 to 4,8	15 to 40	8 to 22
Long-term exposure for awnings, technical and semi-technical articles, like fishing nets, boat covers, ropes, exposed continuously to outdoor weather conditions.	>57	>485	>264

[a] Radiant exposure (J/m^2) is calculated by multiplying irradiance (60 W/m^2) with duration (s). See also 3.5.

[b] Spectral radiant exposure [J/(m^{2}nm)] is calculated by multiplying spectral irradiance [0,51 W/(m^{2}nm)] with duration (s). See also 3.5.

Bibliography

[1] ISO 105-B04, *Textiles — Tests for colour fastness — Part B04: Colour fastness to weathering: Xenon-arc fading lamp test*

[2] ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

[3] ISO 4582, *Plastics — Determination of changes in colour and variations in properties after exposure to daylight under glass, natural weathering or artificial light sources*

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